

47th SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE
ACTIVITIES (D5)

Ensuring quality and safety in a cost constrained environment: which trade-off? (1)

Author: Mr. yang zhao
Northwestern Polytechnical University, China, 815137601@qq.comVIRTUAL FAULTS SIMULATION OF THE METALLIC THERMAL PROTECTION SYSTEM AND
ITS MODEL-BASED FAULTS INJECTION**Abstract**

Metallic thermal protection systems (MTPS) are being studied as a potentially more robust, lower maintenance alternative to the existing ceramic TPS for future reusable launch vehicles (RLVs). Investigation on MTPS and its failure modes is very helpful for its design and health monitoring. The statistics of historical faults show that its most typical failure modes include coating flaking, strike damage, panel-to-panel gap etc. For the MTPS panel, based on three-dimensional finite element models, three typical failure modes are simulated to obtain its thermal features and to figure out these failure modes effect. The simulation results show that coating flaking greatly would reduce the outer surface's radiation ability, and strike damage would lead to the loss of insulation materials. Both of them would result in the sharply rise of temperature responses in these damage zones. With some panel-to-panel gaps, which would occur for the installation errors or the MTPS panels deformation etc., the temperature in the region near the gap will be far higher than the other parts in the same horizontal position, the temperature at the bottom of the MTPS panel near the gap would exceed the normal value. To valid and verify the FE model accuracy, a faults injection system has been established, which can automatically complete the injection of multiple faults of MTPS. The corresponding thermal contours in various cases and the curve of temperature at several key points can be obtained. All the results show that it is a more accurate and faster method than traditional fault simulation and provides a verification and evaluation platform for prognostics and health management (PHM) technology of MTPS.